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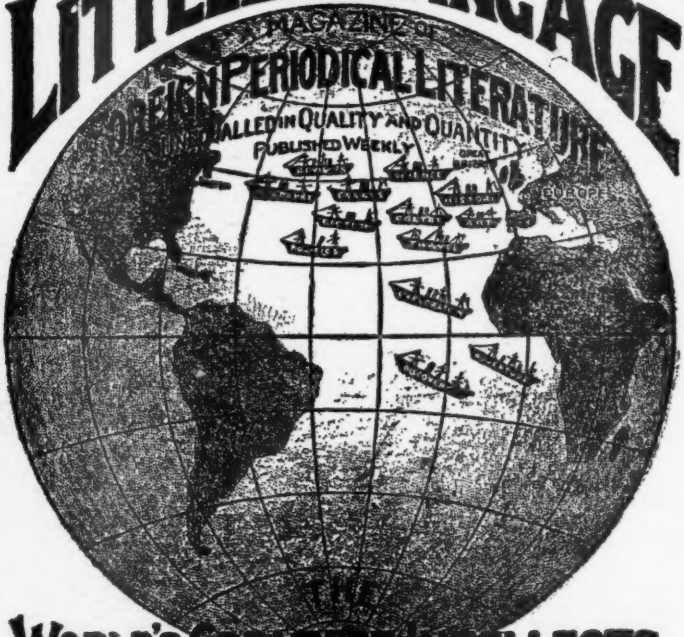

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THE AMERICAN

METEOROLOGICAL JOURNAL.

VOL. XII. BOSTON, MASS., JANUARY, 1896. No. 9.

THE AUDIBILITY OF FOG SIGNALS.

PROF. H. A. HAZEN.

THE recent grounding of the valuable passenger steamer "Puritan" on Great Gull Island calls attention very forcibly to several points brought out in my paper in this JOURNAL for October. This accident occurred in a dense fog, within five thousand feet of a second-class siren which was sounding at full blast. This siren has been heard to a distance of at least twenty miles, under favorable circumstances, in its axis, that is, toward the north. The point of wreck is nearly due west from the siren and at the time there was a strong wind from a southerly direction. This point is precisely where the bones of the steamer "Branham" lie bleaching to-day. This valuable vessel was lost in 1875 in a dense fog.

Capt. Miner, of the steamer "City of Worcester," approached the island from the west, just at the time of the accident to the "Puritan." He declares that his lookout was unable to hear any whistle [trumpet] as they approached the island, but after passing the whistle could be plainly heard. "This failure to hear it is proof of an assertion often made by mariners that under certain conditions the whistle cannot be heard and that it is therefore practically useless as a means of warning in fog."

The "Galatea" went ashore at a point just south of and within six hundred feet of this same fog trumpet, which was at full blast the whole time. I have no hesitation in repeating my statement that a twelve-inch steam fog whistle would have amply protected both these valuable vessels, whereas a trumpet is only serviceable near its axis.

It is quite remarkable that so much has been written and said about the aberrations and irregularities of fog signals and

about the difficulty and uncertainty of locating them in a dense fog, when a few suggestions made from a full knowledge of the circumstances under which the signal is operated would do away with nine tenths of the difficulty. Most of these so-called aberrations have arisen in the minds of some persons from two principal causes. First, from observations made at a distance of more than four miles in the axis of a trumpet and of two to two and one half miles from a steam twelve-inch whistle. Second, from ignoring the effects of topography.

A minor cause has been a consideration that the sound of a trumpet spreads on all sides and can be heard almost as well to the rear as in front. This is absolutely false.

The sum total of all the effects of wind, temperatures, humidity, acoustic clouds, etc., if lumped together, would not form one one-hundredth of what has been considered in the line of these so-called aberrations. It is a great pity that this subject has been so confused for the practical navigator by so many side issues which are of no account whatsoever. I challenge a disproof of the following propositions: —

First. In the axis of a first-class siren, situated in the open and with no surrounding islands or eminences or buildings, within three and one half to four miles, the sound will invariably diminish according to the inverse square of the distance, no matter what the wind direction, temperature, humidity, acoustic clouds, or any other commonly recognized causes of aberration may be. Beyond that distance this law no longer holds, but under favorable conditions the sound may be carried to many miles, diminishing but slightly in intensity.

Second. That within two to two and one half miles of a steam twelve-inch whistle, situated precisely like the siren above, there will be practically the same law of diminution in the sound on all sides, with this slight exception, that the sound will be a little louder at the same distance to the leeward than to the windward. Prof. Henry showed that with feeble sounds the hearing was nearly twice as far to leeward as to windward, but this is not at all true for loud sounds, or rather for sounds comparatively close to the instrument. As the distance from the whistle increases the effects of wind, etc., become more apparent and the signal cannot be relied upon.

Fortunately the region to be warned by a signal of this kind

is seldom more than two to three miles in radius, so that a mariner need have no concern if he is approaching an island in a dense fog and knows there is a steam whistle upon it in the open and no point of the island is farther than two to two and a half miles from the whistle.

As a matter of fact, there are no whistles situated in the open and a mariner needs to watch for effects of topography, buildings, etc. The great point for a mariner is not to rely upon the indications of any first-class siren at distances greater than four miles and to a limiting angle of perhaps 30° from the axis, and not to trust a twelve-inch whistle at distances greater than two to two and one half miles. In the case of the second-class steam siren on Little Gull Island, no reliance can be placed upon its indications to windward at any angle greater than 40° or 45° from the axis, especially at distances less than one to two miles away.

I do not mean to say that these signals cannot be relied on to greater distances than those given above under favorable winds, but in cases of danger ahead, with a wind blowing toward or at right angles to the supposed direction of the sound, nothing can be certain except within the distances named.

Nov. 11, 1895.

ATMOSPHERIC PHENOMENA IN THE ARCTIC REGIONS IN THEIR RELATION TO DUST.*

PROF. WM. H. BREWER.

THE effect of dust in the air has been the subject of much study during recent years. Tyndall in his investigations on its biological significance in connection with putrefaction and spontaneous generation, discussed incidentally some of the physical aspects of the subject. Then Aitken pointed out the part it played in the formation of cloud and the condensation of watery vapor. Numerous investigators have since pursued the subject in so many directions that it is hardly too much to say that a new department of Physics and Meteorology has been created. The number of dust particles per cubic inch of air has been determined in many localities and in various conditions of the weather. The relation of these particles to the conden-

* From a paper in the *Yale Scientific Monthly* for June 1895.

sation of watery vapor, to cloud, fog and rain; to the color of the sky; to the transparency of the atmosphere; to the aspects of landscape scenery and to sundry other phenomena, have all been made the subject of special scientific inquiry.

The systematic investigations have, however, been mostly restricted to work in laboratories or observations on the free air of a few regions in Europe and the United States, supplemented by casual observations on certain atmospheric phenomena observed elsewhere in the temperate and tropical zones. So far as I know, the recorded observations made in the polar regions are confined to certain atmospheric appearances commonly observed by arctic explorers and to the fact that dust has been found mingled with snow in the far north.

Laboratory experiments have demonstrated that the formation of cloud, fog and rain is related to, if not indeed practically dependent upon the dust in the atmosphere. Without these particles forming a surface upon which vapor can condense, air must be cooled far below its dew point for the formation of liquid particles of either cloud or rain. It is believed that the character of the rain and fog, as well as the color of the sky, are determined largely by the relative abundance and size of dust particles.

It is obvious that the air of the Arctic regions must be much less dust-laden than our own, and on my trip to Greenland last summer, I made such observations on the various phenomena involved as were practicable. Although these observations were restricted to such matters as could be observed without the aid of special instruments, a record of some of them may be of interest in connection with the general subject.

We sailed from New York, July 7 (1894), touched at Sidney on Cape Breton, then to St. Johns, Newfoundland, thence along the coast and through the Strait of Belle Isle to Labrador at Cape Charles, then returned by nearly the same route to St. Johns, thence directly to Greenland near Cape Desolation and northward to Sukkertoppen, at or near which two weeks were spent, thence back making two stops on the Labrador coast south of Lat. 54°, thence through the Strait of Belle Isle and the Gulf of St. Lawrence to the Isle of Cape Breton, thence back by way of Halifax and Long Island Sound to New York, where we arrived Sept. 11. Daily observations were made as to

the aspect of the sky, fogs, etc., but my written record is incomplete. This paper is written partly from notes made at the time and partly from memory.

After leaving St. Johns, the first noteworthy day was July 16, when we were steaming along the northeastern coast of Newfoundland between Lat. 49° and 51°. It was a clear day with a very slight wind off shore, and at times the air was so calm that the sea was almost glassy. The atmosphere was very transparent, the sky overhead was brightly blue, becoming very pale towards the horizon. The sea horizon itself was very dark but not sharp; on the contrary, was wavy and ill-defined, often ragged and changing in outline, passing into forms of local mirage and "looming up." We were in that great procession of icebergs that came down that coast in the cold current. These bergs were exceptionally abundant and large last summer, and the effects of the distortions due to mirage of those on the horizon was fascinatingly beautiful. Distant bergs would be appearing and disappearing. Marvellous as their shapes are naturally, they were made much more so by this optical distortion. Now magnified and lifted to many times their original height, then flattening out again, their wavy and flickering outline continually changing in the brilliant sunshine. Sometimes they would fade out of sight, soon to be again peeping above the dark but capricious horizon, again divided into two with a belt of dark water between, then coming back to normal form or disappearing entirely below the horizon where a ripple on the sea showed that local belts of light wind broke up the unequally heated layers of air.

The next morning when near the island and in the Strait of Belle Isle, we were again beset with fogs which were very variable as to height, and frequently changing as to capacity and aspect. Sometimes they were white and opaque, at others transparent and misty. When white and opaque, they were less so than the fogs we had met with off the coast of New England and Nova Scotia.

Just north of the Strait of Belle Isle, a collision with an iceberg damaged our ship. A light wind from the land soon dissipated the fog, and at noon we ran into a little harbor behind Cape Charles (Lat. 52° 15′), where we remained four days making repairs.

Rocky hills rise 600 to 850 feet from the harbor, and the coast is cut by fiords into bays and rocky islands. From the tops of the hills we had a wide range of vision, and a slight blue haze, evident, but not so dense as we had found in Newfoundland or Cape Breton, rested over the landscape.

While here, we had alternate rain, fogs, and clear weather, the fogs varying greatly in their whiteness and opacity.

We returned to St. Johns and finished our repairs, and started anew for the north, this time going outside the cold current and ice until sighting the coast of Greenland at Cape Desolation. We were kept off the coast by the abnormal amount of field ice, and were in Davis Strait and Baffin Bay for several days before reaching Sukkertoppen (Lat. 55° 25′). I was at or near this region for about two weeks, during which we had clear, foggy and rainy days.

None of the fogs are so white and opaque as those seen south of Lat. 50°. There is much exaggeration in the popular descriptions of fogs. We often hear of fogs at sea where nothing can be seen a hundred feet away. In fact, such fogs are rare, on either sea or land. Indeed, it is rare that fogs are so opaque that large dark objects cannot be seen two hundred feet.

I saw none in the Greenland seas in which we could not see several hundred feet, and usually very much farther. The fogs were all very much more transparent than those we met with south of New England and Nova Scotia on our voyage out and back.

The fogs were, however, as a rule, very much wetter and more misty. Often, when the fog was so transparent that we could see a half a mile or even a mile from the ship, the water would drip like rain from the rigging and every exposed surface, and our beards and clothes be rapidly covered with fine drops.

Even those surface fogs resting on the water under a clear sky, which shut out the horizon, but with the sun shining through from above, were very wet. The ship's rigging and even our beards would drip. On our return, and when in the dense, opaque fogs we met with south of New England, I noticed the marked contrast in their wetness, so to speak, where at times we could not see a ship's length, but the air did not

appear as if entirely saturated. The decks of ship would dry after scrubbing, and other exposed objects would dry even in the fog. The dust particles in the air over these Southern waters were ample to collect all the moisture, while in the Greenland fogs condensation went on as if there was not nearly dust enough in the air to supply the demand.

The rains observed north of Lat. 53° differed from those at home of the same season in that they consisted only of small drops, mist rather than rain. For example, the heaviest rain we had at Sukkertoppen occurred on August 11. Numerous small cascades poured from the rocky heights, and streams poured from the scuppers of the ship's deck, but the rain was a fine mist. It seemed impossible that such misty rain could wet so fast as this did. The same fact was noticed in numerous other rains, both in the harbor at Sukkertoppen and out in Baffin Bay. In the heavy storm in Davis Strait, in which the steamship Miranda was abandoned on August 23, and when the barometer sank about one and a half inches, the heavy rain was a fine mist. This was in Lat. 61° 15′, and perhaps 200 miles from land. This was the character of all the rains we had while in the north, and on our return until just below Lat. 52°, when in the night we had a shower of large drops. It was of short duration, but the patter of the big drops on the deck told us that we were back again to familiar atmospheric conditions.

The range of temperature must also be a prominent factor in the difference in size of the rain-drops as well as in the opacity of the fog. In our warmer regions, we have not only a greater abundance of dust particles on which condensation may take place, but a greater range of temperature to promote rapid condensation. North of Lat. 58° the surface waters were below 42° F., and when out in the open water the air was rarely above 46°. Often the difference between the air temperature and that of the water was not over two or three degrees, and during the fogs out in Baffin Bay, the difference was usually not more than six degrees, and local patches of fog would sometimes form with temporary changes in the air temperature of a single degree or even less.

The rains, fogs and other atmospheric phenomena of that portion of the north which I saw were just such as we might infer from the paucity of smoke and dust in the air there. Over the

millions of square miles within the Arctic circle, practically no smoke is generated, and but little for many more millions lying in the high latitudes surrounding it. All the other sources of dust are scanty and what is wafted to the regions from more southern climes is washed out rapidly by the abundant rains and fogs. From the nature of the case, the difference between the air temperature and the dew point can never be so great as it is in our latitude.

The effect on the aspects of the sky and landscape are striking, and I think it probable, produces, unconsciously of course, one of the fascinations of Arctic scenery. The sky was a light blue, in the clearest day, and whitish in ordinary clear weather.

During our detention at Sukkertoppen awaiting the arrival of a rescue vessel, I made frequent trips to the surrounding heights, some of which commanded wide and exceedingly grand views. This is considered the boldest and most picturesque portion of Western Greenland. The headlands are lofty and precipitous. The mainland and some of the larger islands are studded with pinnacled and inaccessible rocky peaks, furrowed by numerous narrow gorges containing more or less perpetual snow. The mainland is cut by three fiords which run up the country for forty to sixty-four miles. Beyond these are high and precipitous mountains, the higher ones pinnacles of granite with the great interior snow cap surrounding them, and coming in grand glaciers down through the gaps between them to the fiords. The aspect of the region as seen from the summit is peculiarly grand and striking.

There was absolutely no softening by blue haze as we have in our more southern scenery. The rugged peaks rising from the desolate ice and snow of the interior, or the naked rocks nearer the sea, under the cold gray light, gave a scenic effect very unlike any other landscape I have ever seen. The clouds which hung about the peaks much of the time were ragged and with illy defined edges. I saw no cumulus masses which constitute such a feature among the mountains of temperate and tropical climes. The clouds were usually stratus, and when not covering the whole sky, had illy defined edges.

When not wrapped in clouds or dim in the mist, the rocky peaks were projected against a cold gray sky. I am told that at some seasons of the year there are very brilliant red sunset

cloud effects, but they were seen but sparingly during our visit. We had, however, twice the beautiful rosy "alpenglow" at sunset upon the great snowfields and glaciers.

Where there was any "haze," it was a watery haze, entirely unlike the dry white haze sometimes seen over our western deserts. And there was absolutely none of the blue that gives such a charm to our own landscapes, and which seemed to me more striking and beautiful than ever when we arrived at Sidney on our return, and saw the valley beyond the harbor fading away in the smoky blue distance.

This pure, dust-free air and cool temperature was peculiarly healthful. Its hygienic effects were remarked by all our party, every one of whom returned in excellent health and strength, save one or two cases of minor accidental bruises.

I will await with much interest fuller investigation on the atmospheric dust phenomena of the Arctic regions. A quantitative investigation of the number of particles and comparison in this respect with observations made in other regions is especially needed. Fuller and systematic observation of the various related phenomena, made under other conditions and at other seasons than we had, would be exceedingly interesting.

CURRENT NOTES.

Some of the Connections between Crime and the Weather in Chicago. — Mr. Charles E. Linney, Director of the Illinois State Weather Service, has sent to this JOURNAL the following abstract of a paper read by him before the Indianapolis meeting of the American Association of State Weather Services, entitled *Some of the Connections between Crime and the Weather in Chicago.*

"The many attempts which have lately been made to show the connection between the moods and impulses of the people and the weather resulted in this hasty investigation into the connection between the crime of the city of Chicago and the weather. The results, which I will try to give briefly, are in rather generalized form, because of the size of the undertaking, when an attempt is made to particularize, and the investigation is made in detail. A few of the more important conclusions and the facts upon which they are based, however, may not be uninteresting, and if this beginning should lead to a full and careful investigation, it will not be in vain. The city of Chicago probably offers as good an opportunity for such an investigation as any of the American cities, both on account of the mixed character of its population and the variation of its seasons. But here, as in all American cities, it is probable that the careful police work of the European cities is lacking. Still the work done is amply sufficient, when placed in generalized form, to meet the ends of the present investigation.

"My notes were made from the police records of the city for each month from January, 1888, to December, 1894, inclusive; the total number of arrests for each month and for each division of crime being considered, although many of these should be thrown out as not connected with the matter under investigation, if it is proposed to carry the investigation down to the several classes of crimes and to each day. For it must be evident that there are many crimes which in no way show the moods or impulses of the people, and which could not be in any way connected with the weather, as, for instance, deliberately planned crimes or crimes of long standing, as embezzlement, conspiracy, forgery, adultery, etc.

"In order to eliminate the great increase in crime due to increase in population, I have placed the investigation in percentages, the number of arrests for each month being a certain per cent of the number of arrests for the year, and the entire number of arrests for each month and year for the seven years.

"Beginning with a minimum of 48,119 arrests in 1889, the number rises rapidly to a maximum of 96,976 during the World's Fair year (1893), and decreases slowly with the ending of 1894. During all these years, by far

the largest number of arrests were made under the general and inclusive term designation 'drunk and disorderly.' There has been, however, a constant decrease in arrests under this charge, the percentage dropping from 62, in 1888, to 56, in 1894.

"Taking first a general view of the chart which accompanies the paper on which are given the percentages of arrests for each month from 1889 to 1894, inclusive, with a mean for the months, the normal and actual temperature for each month, we find an increase from a minimum of 5.9 per cent, in February, to a maximum of 10.9 per cent, in August. Also an increase from a minimum of 18.8 per cent for the first three months of the year (approximately the coldest) to a maximum of 31.5 per cent for the months of July, August, and September, approximately the warmest; a fact which at once establishes a marked increase in crime with the increase in temperature. This is further borne out by 21.9 per cent of the crime during the cool spring months, and 26.4 per cent during the warmer fall months. Nearly a third of the crime of the year is crowded into the months of July, August, and September.

"Assuming that there is an increase in crime due to the increase in temperature, some of the individual months should show this coincidence. An examination of the table discloses the following: January, in 1889, shows 7.7 per cent of the crime of that year, which is 1.3 per cent above the normal amount for the month. The records of the Chicago office show that the month was 5 degrees daily above the normal temperature; other weather conditions for the month were rainfall, 0.56 below normal; humidity, 12 per cent above; cloudiness, 1.1 per cent below; wind prevailing southwesterly. January, of 1894, shows 8.3 per cent of the crime of the year. The temperature was 4 degrees daily in excess of the normal; rainfall, 0.65 below; humidity, 5 per cent above; wind, southwesterly; cloudiness, normal. February, in 1890 and 1892, shows 6.4 per cent and 7 per cent, respectively. February, in 1890, was 4 degrees daily above the normal temperature; rainfall, 2.42; wind, southwest; cloudiness, .07 per cent above normal.

"In 1892, February was 2 degrees above normal; rainfall, 1.57; humidity, 85 per cent (normal, 74 per cent); wind, northeast; cloudiness, 1.8 per cent above normal. March, of 1894, shows 7.8 per cent of the crime of that year, with temperature 7 degrees daily above the normal; rainfall, nearly normal; humidity, 1 per cent above; wind, southwest. July and August of each year show a heavy criminal record, but August of 1889 has an exceptionally heavy record. The month was only slightly above the normal in temperature, but was very dry, only 0.39 of an inch of rainfall being measured, and humidity and cloudiness were low, and winds high southwesterly.

"September, 1891, shows 10.7 per cent of the crime of the year. It was 5 degrees daily above normal in temperature, and with a rainfall of only 0.32; also very clear, low humidity, and southwesterly winds. June, of 1890, shows 10.2 per cent of the crime of the year. The month was 4 degrees daily above normal temperature; rainfall, only 0.53; deficient humidity and cloudiness normal, and southeast wind. October, of 1893, shows 9.9 per cent of the crime of that year. Temperature was 1 degree daily above normal; rainfall, 1.66 deficient; humidity, normal; wind, south, and mostly

clear days. October, of 1891, also shows a large increase in crime. The month was 1 degree daily above normal; humidity, 3 per cent below; wind southwest, and clear, but with a rainfall deficiency of 3.05 inches, and three periods of great heat and high southwesterly winds. From which it would appear that throughout the year the months of excess in temperature and of deficient rainfall have a large increase in crime, this increase probably having some definite ratio to these causes.

"On the other hand, it is commonly supposed that a cold winter leads to an increase in crime, want and starvation and cold causing the people to become desperate and to commit desperate deeds. The facts, however, do not sustain the popular idea. A cold month, with normal rainfall, or an average month in temperature, with marked excess in rainfall, at once shows a decrease in crime. Thus March, 1891, shows but 5.1 per cent of the crime of the year. The month is found to be nearly 4 degrees daily deficient in temperature; precipitation, 0.43 per cent deficient; humidity, 11 per cent above; cloudiness, 2 per cent below; wind, northeast. Another striking example is January and February, 1893, the year of the largest criminal record. Only 10.2 per cent of the crime of the year occurred in these two months. January was over 12 degrees daily below the normal, but with rainfall normal; humidity, 12 per cent below; wind, northwest. February was a repetition of January, with a deficiency of nearly 6 degrees daily; rainfall, normal; humidity, 10 per cent below; wind, west.

"February, 1889, follows with a deficiency of nearly 8 degrees daily, and with a very low percentage of arrests. February, of 1894, is the same; also January, of 1892. March, of 1891, shows a deficiency of 4 degrees daily, and only 5 per cent of the crime. September, 1890, had a deficiency of 4 degrees daily; rainfall, only one half of the normal; humidity, 7 per cent above; wind, northeast; but there was only 8.1 per cent of the crime of that year during the month. This is the lowest mean temperature recorded during this month, from 1888 to 1894, and at the same time it is the lowest percentage of crime for that month.

"The effect of excessive rainfall on the criminal record, when temperature was normal, is shown in April, 1893, with nearly one inch excess rainfall; nearly normal temperature; wind, northeast; and only 6.3 per cent of the crime of the year. May, of 1892, had an excess in rainfall of 2.95 inches; was 2 per cent above in cloudiness; 12 per cent above in humidity; wind, northeast; and but 7.9 per cent of crime of the year. Temperature was also 4 degrees daily below the normal. May, 1891, was 3 degrees daily below normal, and with 7.6 per cent of the crime of the year. June, 1892, had an excess of rainfall of 6.80 inches; humidity, 13 per cent above; cloudiness, 2.2 per cent above; normal temperature; and 9.8 per cent of the crime of the year. September, 1894, shows an excess of 5.58 inches of rainfall, with an excess of 2 degrees daily in temperature; nevertheless, the crime was only 9.5 per cent of the year.

"Turn now to some of the specific crimes, and the results under them. Burglary has a constant ratio of 2 per cent of all the crime of the year, from 1888 to 1893 inclusive, during which time the temperature was at or below the normal, but jumps to 3 per cent with the year 1894, when the tempera-

ture for the first time was above the normal. Assault, general and specific, shows a slight fluctuation between 3 and 4 per cent, until the World's Fair year, when it jumps to nearly 6 per cent, but continues to rise, with 1894, to nearly 7 per cent. The same remarkable increase is noted in malicious mischief from a steady average of .4 of one per cent, from 1888 to 1893, inclusive; it jumps to .5 of one per cent during 1894. Robbery follows the course of the others, with an increase from .6 of one per cent, in 1888, to .11 of one per cent, in 1893, the year of maximum crime, but still continues to rise, with 1894, to .12 of one per cent.

"While it is admitted that there are some cases which do not seem to carry out the general rule, it is thought that the general results do show a marked increase in crime with the increase in temperature, probably daily, at least for the months, seasons, and the year. Also that there is an increase in crime with a marked deficiency in rainfall, temperature conditions remaining normal; and again a greater increase where both conditions are aggravating causes. As for humidity, there seems to be no special connection, and also little connection with the cloudiness, except possibly a slight increase in clear weather and a slight decrease in cloudy.

"On the other hand, it is thought that the figures show a decrease in crime with a deficiency in temperature, especially during winter months, or with excess in rainfall in summer, and a greater decrease when both are restraining causes. It is also thought there is a decrease in crime with a northeast over a southwest wind."

Avalanche Blast in Switzerland, Sept. 11, 1895.—On Sept. 11, 1895, at 4 A. M., a destructive avalanche of ice occurred in the famous Gemmi Pass, Switzerland, resulting in the loss of six lives and the killing of over one hundred head of cattle. Mention has been recently made in this JOURNAL (Vol. IX., pp. 95, 96) of the blasts of wind which rush out in front of such avalanches and of landslides, and examples of these winds in Canada and Switzerland were there given. Regarding the avalanche blast caused by the Gemmi ice slide Miss Maria M. Ogilvie writes as follows in *Nature* for Oct. 10: "Although the cause of the disaster was the fall of the ice-mass, it must not be forgotten that the actual destructive force is the wind pressure ('Windschlag') in advance of the falling mass. Living beings and timber are flailed to the ground, or borne to considerable distances. The mass of ice then buries all beneath tons of weight, and transports still farther, tearing and breaking whatever it carries. The enormous rush of wind, together with the terrifying sounds of the avalanche, gave the people of the neighborhood a rough awakening from their night's rest. They thought an earthquake was convulsing them."

In the London *Times* of Sept. 19, a letter from a correspondent at St. Beatenberg, Switzerland, reads in part as follows: "The first indication of anything unusual occurred as we rounded a corner into the widest part of the pass. The field of view was dotted all over with objects that looked like white stones, but which, on closer examination, proved to be blocks of ice, more or less rounded by much rolling. It looked as if two armies of giants had been snow-balling one another. This marked the outer edge

of the avalanche. . . . Then we came across uprooted trees lying about in dire confusion, some almost standing on their heads, with their roots pointing to the sky. Among them the round blocks of ice lay thick. The destruction caused here was mainly the effect of the terrible wind which an avalanche brings with it, and which, on this occasion, even forced stones and blocks of ice over the intervening hills into the neighboring valley. The trees that we found later on, and which had been subjected to the full force of the avalanche itself, were not only uprooted, but stripped of every vestige of leaf and bark. I am told that the bodies recovered were completely denuded of clothing, and much disfigured."

Report of the Meteorological Department of the Government of India for 1894–95. — Mr. John Eliot, M. A., F. R. S., F. R. Met. Soc., has issued his Annual Report of the Indian Meteorological Department for 1894–95. Among the matters of interest the following may be noted: Observations were regularly received during the year from the Seychelles Islands, and proved to be even more interesting and valuable than was anticipated in the light they throw on the changes leading up to the establishment of the southwest monsoon in India. Since April 1, 1895, this has been a permanent observatory, and it is possible that arrangements will be made before May for the receipt of a daily weather telegram from that station during the period April 15 to June 15, in order to test its value as a weather-indicating station for the advent and progress of the southwest monsoon. About 700 sets of storm, cloud, and other special observations in all were sent in by observers during the year 1894, as compared with 530 series in the preceding year. The seasonal forecast of the probable character of the rainfall during the southwest monsoon gave a very fair approximation to the general features of the monsoon. The storm-warning work was carried out satisfactorily by the warning officers at Simla and Calcutta, and ample and definite warning was given in the case of all the more important storms which visited the Indian coasts in 1894–95.

An especially interesting point is in connection with the currents of air in the Khojak Tunnel, on the Mushkaf Bolan Railway. According to the Report, "the current in that tunnel is always found to blow in one direction during fine weather, over the Baluchistan Plateau, and in the opposite direction during disturbed weather. The change from the fine to the disturbed weather direction usually occurs some time before the disturbed weather sets in at Chaman and Quetta, and is regularly telegraphed to Quetta for the information of the railway authorities." In view of this fact, Mr. Eliot determined to make use of this natural weather forecaster, in connection with the Quetta and Chaman observatories, in forecasting the stormy weather of Upper India during the cold season. Arrangements were accordingly made for daily telegrams of the strength and direction of the tunnel currents to be sent during the cold weather, and it was found that they frequently gave valuable indications. Mr. Eliot proposes to continue them during the next cold season or two, in order to determine to what extent they can be utilized in forecasting the approach and character of the cold-weather storms in Northwest India and Baluchistan.

The New Meteorological Station on Mount Wellington, Tasmania. — In this JOURNAL for October, 1895, mention was made of the proposed observatory to be erected on Mount Wellington. In *Nature* for Oct. 17, an account and a view of the new observatory were given. The building was begun last May, and it will take the same place in the Southern Hemisphere that Ben Nevis and other mountain stations do in the Northern. The new station is equipped with a Fortin mountain barometer, Richard barograph and thermograph, dry, wet, and maximum and minimum thermometers, and a five-inch gauge, with extra deep rim for retaining snow. Similar instruments are used at the Springs (2,495 feet above sea level) and at Hobart (160 feet above sea level).

These stations were organized by Mr. Clement L. Wragge, of the Brisbane Weather Service. "Very valuable results, bearing upon the distribution of pressure, temperature and humidity attaching to anticyclonic and cyclonic systems through vertical sections of the atmosphere in the Northern and Southern Hemispheres, respectively, will probably be forthcoming when the Mount Wellington and Hobart results appear and are discussed side by side with those obtained at Ben Nevis and Port William. Except for a few degrees of latitude, Mount Wellington and Hobart are geographically and physiographically almost the very counterparts in the Southern Hemisphere of Ben Nevis and Port William in the Northern."

First Winter Storm of the Pacific Coast.— The following is taken from the Portland, Ore., daily weather map for Nov. 12, 1895, 5 A. M., Pacific Time, and was written by Mr. B. S. Pague, Local Forecast Official at Portland: "The first winter storm of the season is shown on the map this morning. The conditions as shown are those peculiar to the winter season and represent the passage of the dry season and the appearance of the wet season. On April 20 last the first type of summer, dry, conditions appeared. It was then stated that from this date (April 20) the rain would be light and of a local more than of a general nature. The conditions from April 20 to date show how well the remarks then made were verified. The phenomenal dry season, which has prevailed over the Pacific Northwest for the past six weeks, was due to the storm areas passing from the north, east of the Rocky Mountains, to the southeast toward the Great Lakes. Usually the storms have this movement during the months from June to the middle of September, when they assume their winter course, and move southward along the coastline, striking land about Vancouver Island, then moving eastward, or at times they move in other directions. The period of dry weather is now over. It is probable that short periods of fair weather may prevail, but it is not probable that any extended period of fair weather will again prevail until next spring. Since April 20 last, the conditions were more in favor of dry weather than of wet weather. From now on, the reverse of this will be true."

Annual Report of the Iowa Weather and Crop Service. — Mr. J. R. Sage, Director, and Mr. George M. Chappell, Local Forecast Official and Assistant Director, of the Iowa State Weather Service, have issued the Annual Report of their service for 1894. During the year 28,500 copies of

the Monthly Review, and about 40,000 copies of the weekly crop bulletin were issued. The observers and crop correspondents number 1,100, the display stations 102.

The highest temperature was 100°, the lowest 28°, giving an extreme range of 128°. The greatest monthly range was 31.1°, in July, and the least 15.5°, in December. The greatest daily range was 42°, on July 23 and May 13, and the least 4°, on Dec. 23. The total number of days with maximum temperature 90° or above was 48; with maximum temperature at 32° or below, 42; with minimum temperature at or below 32°, 133. The total snowfall was 23 inches, the total precipitation 27.47 inches. September had the greatest precipitation (5.26 in.), and July the least (.39 in.). The last killing frost was on May 19; the first snow fell on Nov. 10. Several tornadoes were reported during the year.

The Audibility of Fog Signals at Sea. — A further contribution to the discussion on the audibility of fog signals is published in the September Pilot Chart of the North Pacific Ocean, as follows: "The navigating officer of the U. S. S. 'Marblehead' reports to the Hydrographic Office that the fog bell at the Needles, Isle of Wight, is unreliable on account of its sound being muffled by the cliffs at that point. At 1 P. M., May 26, 1895, that vessel, in company with the U. S. Flagship 'San Francisco,' anchored during a dense fog 2.4 miles S. by E. ½ E. from Needles point without having heard the fog bell, the sea being smooth, with light airs from southeast. About 5.30 P. M., with light easterly airs and a smooth sea, the fog bell was distinctly heard.

"One of the officers of the British steamer 'Catalonia' reports that at 11.20 A. M., local time, on July 16, that vessel passed within five hundred yards of the lightship at Daunt Rock, south coast of Ireland, during the prevalence of a fog. The officers of the 'Catalonia' noted the smoke of the fog gun, which was discharged several times while the lightship was in sight, but were unable to hear the report of the same until at a distance of one and a half miles or more, when it was distinctly audible."

Annals of the San Salvador Astronomical and Meteorological Observatory. — Dr. Alberto Sanchez, Director of the Astronomical and Meteorological Observatory of San Salvador, has issued the volume of *Anales* of his institution for 1895. This number contains the observations for 1894, which have been regularly kept up during the year. Several new instruments have been purchased, and a seismological service is soon to be instituted. The energetic director is very much hampered in his efforts to extend the meteorological work in San Salvador by lack of funds, and by the opposition he meets with in the Assembly.

Meteorological Observatory at Alfred University, Alfred, N. Y. — A new meteorological observatory has been established at Alfred University, Alfred, N. Y., under the charge of Mr. Laurence LaForge, who has been appointed meteorologist at the University. The observatory is under the direction of Prof. H. C. Coon, M. D. The equipment is at present as

follows: maximum, minimum, wet and dry bulb thermometers, murcurial barometer, Draper thermograph, anemometer, recording rain-gauge, sunshine recorder. A Richard thermograph and barograph are to be purchased directly. Special attention is to be paid to the effect of topography upon climate, and numerous rain-gauges are to be put into operation in order to determine the rainfall at different places in the neighborhood.

Weather and the Cultivation of Beets in Germany. — Dr. C. Kassner, of the Prussian Meteorological Institute in Berlin, has a paper in the "Deutsche Zuckerindustrie" for Oct. 4, 1895, on the relation between the beet crop and the weather in Saxony and in Silesia. He calls attention to the need of more meteorological observations taken at stations situated in the great beet growing districts, in order that there may be a better basis of comparison between the variation of the temperature and rainfall and the amount of the crops. In this investigation the author has compared the mean maximum and minimum temperature, the precipitation (amount and number of days), the cloudiness and the sunshine at Magdeburg and at Breslau with the yield of beets per hectare. The result shows that in Saxony the yield is much more dependent on the precipitation than on the temperature, while in Silesia it is more dependent on the temperature. The exposure of the thermometers is such, however, that the temperature of the air can be much better obtained at Breslau than at Magdeburg, which partly accounts for the apparent discrepancy between the two conclusions. As a whole, the results may be summarized as follows: The yield increases or decreases as a whole as there is an increase or decrease in the mean temperature, and the amount and number of days of precipitation.

Photographs of Tornadoes, Storm-Waves, Ice-Storms, etc. — The Editor of this JOURNAL is desirous of increasing his collection of photographs of damage done by tornadoes, of storm-waves, hail-stones, ice-storms, trees growing unsymmetrically as the result of wind action, floods caused by sudden and heavy rains, damage by lightning, valley fogs, and other meteorological phenomena. Any one who has such photographs for sale is requested to communicate with Robert DeC. Ward, Editor of the AMERICAN METEOROLOGICAL JOURNAL, Cambridge, Mass.

Corrigenda. — The following corrections of the text of Prof. Moore's paper in the November number of this JOURNAL were sent in too late for publication in that number.

Page 210, line 21, for *line* read *lines*.

Page 210, omit the foot-note.

Page 211, line 24, for *drawing warm easterly currents in* read *drawing in warm easterly currents*.

Page 211, line 25, for *westerly currents into the rear* read *westerly currents at the rear*.

Page 212, lines 5 and 6, for *south and west quarters* read *westerly portion*.

Page 213, omit the first sentence on this page.

Page 213, line 22, for *with kites at* 1,000 *to* 2,000 *feet elevation* read *with kites at elevations of from* 1,000 *to* 2,000 *feet.*

Page 214, lines 34 and 35, for *products which were indigenous to limited areas, or interests which were of special importance*, read *products that are* and *interests which are.*

Page 215, line 20, for *beneficent* read *beneficial.*

Page 216, line 4, for *Wisconsin State Weather Service* read *State Weather Service of Wisconsin.*

Page 216, line 25, for *previous* read *preceding.*

Page 216, line 27, insert *observed* before *town.*

Page 216, line 3, for *stable temperature condition of water* read *stability of water as to temperature.*

Page 217, line 16, omit *energy.*

Page 218, line 19, for *stable* read *equable.*

Page 218, line 26, for *diverted* read *averted.*

CORRESPONDENCE.

PROF. ESCHENHAGEN'S METHOD FOR DETERMINING THE TEMPERATURES OF DISTANT OR INACCESSIBLE PLACES.

The Editor of the American Meteorological Journal: —

In the June number of this JOURNAL was described an instrument, termed by the inventors, H. E. Warren and G. C. Whipple, a *thermophone*, devised for the same purpose as Prof. Eschenhagen's contrivance. The authors prefaced the account of their own method by an enumeration and brief descriptions of previous methods. As they, evidently, were not aware of Prof. Eschenhagen's labors in this direction, it may not be amiss to call attention to them. The Eschenhagen method will be found published in the "Zeitschrift für Instrumentenkunde," November, 1894, under the title, "Ueber ein Quecksilberthermometer mit Fernbeobachtung durch elektrische Uebertragung."

Prof. Eschenhagen's object, briefly characterized, was to determine electrically with the aid of a telephone the temperature reading of a specially constructed mercurial thermometer located at some distant or inaccessible place, such as mountain tops, captive balloons, and especially ocean depths.

The determinations were not to be liable to a greater uncertainty than the direct reading error (about 0.1° C.). The principle was this: A fine platinum wire, 0.03 *mm.* in diameter, was drawn through the entire length of the tube (cross-section, 1 sq. *mm.*) of a mercurial thermometer and melted in the glass at the bottom and at the top.

Let R_1 be the electrical resistance of the mercury column, of length l_1, cross-section q_1, and conductivity k_1 (let R_2, d_2, and q_2 and k_2 represent the same quantities for that portion of the platinum wire projecting out of the mercury), then will R, the total resistance, $= R_1 + R_2 = l_1 / k_1 q_1 + l_2 / k_2 q_2$. If now the temperature changes, *i. e.*, l_1 and l_2 change by Δl, then will $\Delta R = \Delta l (1 / k_1 q_1 - 1 / k_2 q_2)$, or the change in R is directly proportional to the change of length of mercury column or free wire. A temperature change can consequently be measured in terms of the unit of electrical resistance (ohms).

Putting $\Delta l = 1$ *mm.*, $k_1 = 1$, $q_1 = 1$, $k_2 = 7$, and $q_2 = \pi (\frac{0.2}{2})^2$, it is found that $\Delta R = -199/1060 = 0.188$ ohm. If now 1 *mm.* on the mercury column corresponds to 1° C., we have, corresponding to a change of 0.1° C., a change in R of 0.0188 ohm, a quantity easily detectable with the telephone method.

For details as well as for a discussion and a determination of the various sources of error to which a temperature determination by this method is

liable, we must refer the reader to the original article. It may be stated that the inventor of the tele-thermometer found, from a three months' comparison between the direct readings and those obtained electrically, that the latter were liable to an uncertainty of about 0.1°, an amount about equal to the direct reading error. The electrical determination required, at the most, one fourth of a minute.

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BIBLIOGRAPHICAL NOTES.

METEOROLOGICAL OBSERVATIONS IN GREECE.

HEINRICH HARTL. *Meteorologische und Magnetische Beobachtungen in Griechenland.* Separat-Abdruck aus den Mittheilungen des K. und K. militär-geographischen Institutes, XIV. Band. 8vo. Wien, 1895. Pp. 55. Pls. V.

We have lately received from Col. Heinrich Hartl, of the Imperial Military Geographical Institute in Vienna, a report on the meteorological observations made under his supervision in Greece during parts of the years 1893 and 1894. Col. Hartl was ordered to Greece in 1889, in company with two other officers in the Austrian army, in order to take part in the survey of that kingdom proposed by the Greek government, and during his stay he was able to make a series of valuable observations on the refraction of light by the atmosphere, a matter of great importance in geodetic work, as well as on meteorology and magnetism. The meteorological observations were begun in 1893, when the instruments brought from Vienna were set up at the city of Argos, where the headquarters of the trigonometric survey were located. The observations were carried on from May 16 to Oct. 15, 1893, the latter date being the one on which the return journey to Vienna was begun, and the instruments had therefore to be packed up. In 1894, the instruments were not in working order until Aug. 16, and observations were continued until Nov. 15. Although thus fragmentary, the observations have enabled the author to point out several interesting facts in regard to the climate of Greece which are worthy of note.

The instruments in use were, besides the ordinary thermometers, in 1893, a Richard self-registering barograph and thermograph, and in 1894, a hygrograph, the sheets of which had to be changed every day, each sheet giving the record for twenty-four hours. A good deal of trouble was caused by the irregularity of the clocks, especially of the thermograph clock, which gained over one hour a day, and by the unevenness of the sheets. The barograph was placed in a large room, in which the temperature was nearly constant, and close to it lay four of the best Naudet aneroids, which served to check the readings of the barograph and to give the necessary corrections. It was found that the barograph was as accurate as the best aneroids. The

thermograph and hygrograph were carefully tested in Vienna before being sent to Greece, and their corrections determined.

The city of Argos, at its northwestern end, reaches the higher land of the Aspis (117 m.) and the steep slope of the hill on whose summit are the ruins of the old castle of Larissa (286 m.). In all other directions lies the level surface of the plain. The open-air instruments were placed in the east window of an isolated building whose front runs in the direction W. S. W.–E. N.E. This window was in sunshine only a short time in the early morn. ing, and an artificial shelter was therefore erected on its eastern side. Argos is 5½ kms. from the sea at its nearest point (the Gulf of Nauplia). The barometer was 22.3 m. above sea level. In 1893, humidity records were made by the use of a travelling psychrometer; in 1894, as already stated, a hygrograph was added to the equipment. Wind direction and velocity and precipitation were observed without instruments.

The prevailing weather conditions in the months May to October are marked by extreme regularity. Low absolute humidity, a small amount of cloudiness, strong insolation and high temperatures, infrequent and usually moderate precipitation, and very few thunderstorms, which are never violent, are characteristics of summer in Argos. The shade temperatures reach 40° C. (104° F.) or over, in July and August, and during the hottest hours of the day all toil ceases. Sleep is impossible. Cooling drinks are not to be had outside of Athens, where artificial ice is made. Freshly drawn well water has a temperature of 15° to 18° (59° to 64° F.), and is kept in porous vessels as in India, evaporation from which keeps the temperature at about 68° F. The curious sensation which he experienced when grasping a thermometer by its bulb on a hot afternoon is noted by the author. Instead of a rise in the mercury, owing to the heat of the hand, there was a fall, blood heat being lower than the temperature of the air. When the sun has set, every one comes out from his hiding-place, and windows are opened, but there is very little relief, and a restless sleep leaves the inhabitants in a tired and worried condition for the following day's work.

There are two types of summer weather, depending on the direction of the wind. The author defines these as a sea-breeze type and a land-breeze type. The morning of a sea-breeze day is cloudless and calm, with the temperature minimum at sunrise, and a rapid rise as soon as the sun has risen. Between 9 and 10 A. M. there comes a breath of air from the sea, which every one welcomes as the forerunner of the longed-for cooling. This breath is of short duration, and is followed by a calm, with increasing temperature. Between 11 and 12 the sea-breeze really begins, at first only at intervals, later as a steady wind, the direction being south. In the afternoon, it attains a force of 3 or 4, perhaps even 5, and towards sunset it ceases entirely, and is followed by a calm. A considerable amount of cloudiness causes a decrease in the strength of the breeze. The land-breeze type is caused by the winds from the two northern quadrants, known to the ancients as Etesian Winds and now called by the Turkish name, *Meltemmia*. These winds usually last several days; are most pronounced in July, August, and September, sometimes even in October, although they

are weaker in the latter month. They may be either warm and hot, or cool. Over the plain north of Eleusis they are very hot, coming in squalls, and accompanied by huge dust whirls. Under these circumstances these winds have a foehn-like character, as they have crossed over a range of mountains 800 meters high. In other regions, especially on the ocean, these winds are cooling.

The barograph curves are very regular, and the amplitudes very small, averaging 2–2.5 mm. The hours of the morning minimum, the noon maximum, and the afternoon minimum gradually shift towards noon from May to November. The land-breeze type has a much higher morning maximum and a much lower afternoon minimum than the sea-breeze type.

The thermograph curves on sea-breeze days show a maximum between 10 A. M. and noon, seldom later, and then a descent through afternoon, evening, and night, to the morning minimum. The curve shows, during its ascent and in the afternoon hours, until shortly before sunset, little short waves, and later, during the night, usually long, flat waves. Sometimes, however, there are short, well-marked waves during the night. These the author believes to be due to the descent, from the mountains northwest of Argos, of currents of air on their way towards the warmer ocean, these being warmed by descent in the same manner as the foehn. The land-breeze type is much flatter. The maximum comes about 4 or 5 P. M., and is followed by a very slow fall. When a strong wind blows, during the day, the curve has many little sharp, superposed curves on it, which are probably due to the squally character of the wind. The minimum, which comes at 4 A. M. in June and July, gradually falls later and later, to 5 or 6 A. M. The maxima vary from 11 A. M. to 2 P. M.

The humidity records show some very interesting sudden changes, as, for instance, on Oct. 20, 1894, when between 5 and 6 A. M., in twenty minutes, there was a change in the relative humidity of 42 degrees. These sudden changes are ascribed by the author to the foehn-like descent of air from the higher land northwest of the city. These descending currents are probably very weak, and would go entirely unrecorded were it not for the self-registering instruments. A point in regard to cloud formation over hill-tops on sea-breeze days is noted as being characteristic. It often happens on such days that between 8 and 10 A. M., when the sky is otherwise clear, little balls of cloud form over the highest points of land in the neighborhood, until the outline of the chain of hills can be traced by the position of these clouds in the sky. After 10 A. M., however, these clouds are usually all gone.

Col. Hartl's report contains further complete tables of his observations, and some excellent reproductions of a large number of barograph, thermograph, and hygrograph curves, illustrating the various points brought out in the text. The author is evidently thoroughly interested in his work, and, although he is handicapped by the small number of observations he has taken, he has made a most valuable and, we are glad to add, a most readable, report on the meteorology of this historic region. We only hope that the observations may be continued, and that Col. Hartl will give us a further report at an early date.

WEATHER AND DISEASE.

ALEX. B. MACDOWALL, M. A., F. R. MET. SOC. *Weather and Disease. A Curve History of their Variations in Recent Years.* 8 vo. London, 1895. Pp. 82. Pls. 36.

Mr. MacDowall's little book on "Weather and Disease" adds another to the rapidly increasing number of publications on the medical side of meteorology, a branch of the science which is certain to receive more general attention and more careful study in the future than has hitherto been given it. We are glad to note that the United States Weather Bureau is now in line with the European countries in giving prominence to sanitary climatology, and feel sure that "Climate and Health" will be the means of arousing interest in this country in this most important subject, on the border land between medicine and meteorology, and yet overlapping the domains of both of these branches of study. The United States needs more teaching of climatology in its medical schools and more study of the medical side of it by its physicians. We recently made inquiries as to how much was taught the students in one of our oldest and best medical schools in regard to the climates of the world and their relation to health and disease, and the answer was, "Nothing at all." We do not know how far this same answer would apply in other cases, but we have reason to fear that it is true of a good many, if not of most, of our medical schools. It is our intention, if time permits, at once to make a systematic investigation of the condition of meteorological teaching in the institutions in the United States where medicine is taught, and the results of our research will be made public in this JOURNAL. We fear, however, that they will not be flattering to our country. It is high time that we followed the example of Great Britain in the matter of requiring a knowledge of meteorology on the part of those who are to be charged with the duty of caring for the public health. As we read in the most recent English work on meteorology, "Every medical man who enters Her Majesty's service is required to study the broad facts relating to meteorological observation, and afterwards is called upon to aid in building up a science of climatology. . . . And now meteorology, than which no science is more closely analogous to that of medicine, takes its proper place in the cirriculum and in the examination for the diploma in state medicine, public health, or sanitary science, which has been made a registrable qualification under Section 21 of the Medical Act, 1886." (Moore's Meteorology, page 3.)

Mr. MacDowall has prepared a very interesting and instructive little book, adopting largely the graphic method of presentation which, although of great value in making clear such relations as he sets forth in his pages, he believes is far too little used. In this we quite agree with the author, and almost any one who looks over the curves in this book, and sees how plainly the facts stand out, will have the same feeling. With each set of curves, — and there are in all thirty-six different ones, — there is a page, or less, of text, briefly explaining the diagram and calling attention to the main features it presents. The list of curves is as follows: I. Weather. 1. The

rainfall of England. 2. The wettest and driest month. 3. The best ten days of summer. 4. The winters of this century. 5. Another view of our winters. 6. The occurrence of very cold days. 7. Long frosts. 8. A long wave of temperatnre. 9. A remarkable winter (1890–91). 10. The summers of this century. 11. Spells of heat and their progression. 12. Bright sunshine in spring, summer, and autumn. 13. Bright sunshine in the winter half. 14. Sunspots and thunderstorms. 15. Sunspots and the relation of raindays to rainfall. 16. Sunspots and spring rains at Geneva. 17. Sunspots and the temperature of the first quarter. 18. Early and late seasons; harvest dates. 19. Early and late seasons; first flowering of plants. 20. London fog; east winds in spring. II. Disease. 1. Measles. 2. Diphtheria. 3. Whooping-cough. 4. Scarlet fever. 5. Enteric or typhoid fever. 6. Diarrhœa and dysentery. 7. Small pox since 1838. 8. Two centuries of small pox. 9. Progression in the summer death wave. 10. Waves of influenza. 11. Quarterly deaths from whooping-cough and measles in London. 12. The incidence of disease in different towns. 13. A general view of London disease in 1893–94. 14. Some zymotic diseases in London, 1893–94. 15. Respiratory diseases in London in the first quarter. 16. Zymotic diseases in severe and mild winters.

The foregoing list will serve to show the scope of the book under discussion better than any other description could do. The points that particularly interested us are the "long wave of temperature," which shows a crest, when smoothed, at about ten years intervals from 1850 on; the "summers of this century," the curves of which also show a certain regularity with intervals of about ten years for a considerable period; the "London fog" curves, which indicate a period of six or seven years, with a tendency of the winters of late years to become freer of fog. All the disease curves are very interesting, and well worth careful study. The diphtheria diagram shows a striking increase of this disease in recent years, but the author believes that "there is some reason to think the disease is subject to a long cycle, a wave crest of which we have been lately approaching." In the case of whooping-cough a relatively high point is reached every three to five years; scarlet fever reaches wave crests every four to seven years; typhoid fever shows a steady decline; zymotic diseases are more prevalent in mild than in severe winters.

We have given considerable space to Mr. MacDowall's book because, although the book itself is not of any very great importance, it marks a step in advance, and should lead to the preparation of similar curves for other countries. Criticism might be made of the selection of subjects for illustration under the weather curves, some of which seem to us unimportant, and of the rather incomplete references. We prefer, however, to say nothing further on this side, and commend the book as a useful one to physicians and to meteorologists.

CLIMATE AND HEALTH.

Climate and Health, edited under the direction of Prof. Willis L. Moore, Chief of Weather Bureau. By W. F. R. Phillips, M. D. U. S. Department of Agriculture, Weather Bureau. No. 1. *A Summary of Statistics for the Four Weeks ended July* 27, 1895. 4to. Washington, D. C., 1895. Pp. 25, Ch. 20.

We have already noticed in this JOURNAL the circulars issued by the new Sanitary Climatology Division of the Weather Bureau, and have referred to the new publication that this division was to issue. This publication is now at hand, and bears the title, "Climate and Health." It is edited under the direction of the Chief of the Weather Bureau, by Dr. W. F. R. Phillips, who is in charge of the division of Sanitary Climatology. In its general appearance it resembles very closely the "Monthly Weather Review."

The first number of "Climate and Health" contains a summary of statistics for the four weeks ended July 27, 1895. In the preface the editor says that the publication "is presented to the professions to which it especially appeals, as being almost wholly experimental in the sort of information it contains, and in the manner and plan in which the different statistics are published. It is offered not so much for its present value as it is as an earnest of future endeavor, should the work it represents meet with the approval of the classes for which it has been particularly undertaken. . . . The statutory organization of the Weather Bureau confines its work to climate and meteorology, and it can employ its activity in other fields only in so far as they are directly related to or affected by these sciences. Therefore, it must not be expected, nor is it contemplated, that the Weather Bureau shall enter into competition with either State or Federal establishments, on medical or sanitary affairs, nor duplicate the work done by them. The general aim of the Weather Bureau in this new field of work will be to collect the meteorologic and hygienic statistics that may be considered by sanitarians and medical climatologists of the greatest correlative importance and to publish them in the shapes most acceptable and useful to these professions."

The statistical data given in "Climate and Health" are as follows: Table I Actual pressure in inches (mean; departure from normal; highest; lowest; range). Temperature in degrees Fahrenheit (mean; departure from normal; highest; date; lowest; date; absolute range; greatest daily range; mean maximum; mean minimum; mean range; mean wet-bulb [sensible]; mean dew point). Humidity (mean absolute; mean relative). Precipitation in inches (total; average daily departure; duration in hours and minutes). Number of days clear, partly cloudy, cloudy, rainy. Wind in miles (average daily movement; prevailing direction; maximum velocity). Sunshine (total number of hours; percentage). Table II. Temperature accumulated (weekly; since Jan. 1). Mean depression of wet bulb. Dryness (absolute, relative). Mean daily humidity (inspired; expired; excess). Precipitation accumulated (weekly; since Jan. 1). Total deficiency of sunshine. Table

III. gives morbidity due to certain causes, by States, and Table IV. the mortality from different causes. These tables are given for each of the four weeks of July. There are, further, five charts for each week, showing, respectively, I., the actual pressure, departures and ranges, prevailing and normal winds; II., mean temperatures and departures from normal, mean wet-bulb temperatures, and differences; III., departures from normal precipitation, absolute humidity and relative humidity; IV., highest and lowest temperatures; V., mortality, death rates and climatologic diagram.

It will be seen, from the foregoing, that "Climate and Health" presents a very great deal of material, in a very compact form. Indeed, one is almost staggered by simply reading over the headings of the different columns of data. The amount of labor that must have been spent in collecting this information and in arranging it in proper form for publication does great credit to Dr. Phillips. We are very glad to see this new publication, which is in line with the striking advance that has lately been made in sanitary climatology, and we hope that it may receive the hearty support of medical men all over the country. At present, the data as to mortality and morbidity are very incomplete. The vast amount of data in tabular form in this publication suggests the thought, will it all be made as useful as it should be? If it remains simply tabulated, by weeks, without any careful study and generalization, "Climate and Health" will be another meteorological volume laid away on a shelf, full of dry statistics, not worked up. But if the material the Weather Bureau is collecting and publishing in this way is made good use of, as we have no doubt it will be, then the results to medical climatology cannot fail to be of great importance.

THE PREDICTION OF SQUALLS AND TORNADOES.

The well-known French writer, M. E. Durand-Gréville, has lately devoted considerable study to the various kinds of squalls. In a paper treating of the wind in them, presented to the *Congrès de la Science de l'Atmosphère* at Antwerp, in 1894, he considers that all squalls, whether accompanied by hail, thunder, or rain, have the same origin, and that these attendant phenomena depend on the variable hygrometric state of the air. All are characterized by a sudden increase of wind velocity and a change in its direction, and by an abrupt rise in the barometer. Squalls, like thunderstorms, occur in that portion of a barometric depression where the S. W. wind changes to W., the line of squalls moving parallel to itself in an average E. N. E. direction with the depression, and extending sometimes more than six hundred miles along one or more radii S. E. of it.

Some remarkable squalls which extended across Europe are represented on synoptic charts, and their possible prediction considered, based on the form of the squall radius, its probable speed, and the force of the accompanying wind. From special telegrams, or by an addition to the usual morning despatches from the European stations, when a squall has passed, stating the time of passage and the force of the wind, the author thinks that predictions for eastern sections may be issued accurately and speedily enough to be useful to agricultural and coastwise interests.

M. Durand-Gréville's second memoir, relating to squalls and tornadoes in the United States, is published in the *Annales du Bureau Central Météorologique de France*, 1892, Part I., and continues his study of squalls and thunderstorms in the *Annales* of the previous year. After stating the relations of squalls to areas of low pressure, M. Durand-Gréville finds from Finley's tornado reports a remarkable analogy in the direction, mean maximum, and minimum velocities of these low areas, and of tornadoes, which cannot be attributed to chance.

He next shows that the local conditions under which thunderstorms and tornadoes occur are similar, and that they often co-exist. These favorable conditions are thus stated: During the winter months the areas of low pressure in the United States often have the apexes of their parabolas in the Gulf of Mexico or in Texas, but generally, and especially during the summer, the low areas commence further west and enter the continent from the Pacific. Such a depression, arriving between California and Canada, may carry with it a belt of more or less violent winds, 600 to 1,200 miles north and south or northeast and southwest, and 12 to 50 miles wide, which moves toward the east parallel to itself. At the hour of its arrival there is somewhere on the globe a zone about 45° broad, extending north and south, which has had the sun directly overhead for some hours, and in whose interior, therefore, the temperature is higher than in the zones which border it east and west. It is in this zone that the local conditions necessary for the production of thunderstorms and tornadoes are generally found. The belt of squalls and the zone of thermal maximum are moving in opposite directions, the first going toward the east at the rate of 10 to 60 miles per hour, the second towards the west with a constant velocity of 15° of longitude per hour. Unless the squall belt breaks up (which it does sooner or later) the belt and the zone will approach each other, coincide during a few hours and then separate. The next day, if the former persists, they will again cross several hundred or thousand miles towards the east, according to the velocity of the depression. It the meeting takes place between the Rocky Mountains and the Pacific there will be no tornado; if it occurs in the Mississippi or Missouri Valleys, the occurrence of tornadoes will be probably according as the squall wind is stronger and the local conditions in the zone are favorable. The same rule holds for thunderstorms, only these, scattered along the squall belt, will be much more numerous. From these theoretical considerations, and from deductions from the inflexions of the isobars in tornadic depressions, the author believes that the prediction of tornadoes 12 to 24 hours in advance, in States subject to their visitation, may be made more definite than at present, and on account of the great destruction wrought, he thinks that the relatively small cost of a system of stations provided with self-recording instruments reporting to the central office should not prove an obstacle to their establishment. A. L. R.

STATISTICS OF STATE WEATHER SERVICES.

OLIVER L. FASSIG. *Statistics of State Weather Services.* Reprinted from the "Monthly Weather Review" for June, 1895. 8vo. Pp. 8.

Mr. Fassig has given a collection of statistics in his present paper which will be found of much value and interest to those who are working in meteorology in the United States. It has been our intention for some time to prepare such a list as Mr. Fassig has published, and we have so stated it in this JOURNAL (Vol. X., 1893–94, page 366), but we are very glad to see that the work has been done by the energetic Librarian of the Weather Bureau, and we need not add that it has been done much more accurately than we could have done it.

The information given concerning each State Weather Service includes: (1) the name of the State; (2) the location of the central office; (3) the name of the director on July 1, 1895; (4) the date of organization and by whom organized; (5) the date of the first weather report and the first weather crop bulletin published; (6) the character of the first report, whether printed or milliographed; (7) the number of active stations on July 1, 1895; (8) the title of the report issued for June, 1895; (9) remarks. It will be seen that this gives very full information, which is certain to be useful to many persons who are working in the climatology of the United States. We have had occasion almost every month to call attention in this JOURNAL to the publications of some one or more of our State weather services, which are doing such admirable work in collecting and publishing meteorological data, and we are always glad to hear of the increase in numbers of their volunteer observers and of the improvement in their publications. We fully endorse what Mr. Fassig says in regard to his regret "that some uniform size and style of printing has not yet been adopted for the publication of these valuable reports." At present it is a difficult matter to file these reports, which are of many different sizes and shapes.

METEOROLOGICAL TABLES.

L. GROSSMANN. *Meteorologische Divisionstafeln.* 4to. Altona, 1895. 4 tables, 1 supplementary table, and 1 page explanatory text. Price, 50 pfennige.

Dr. Grossmann, who is an assistant in the German Naval Observatory at Hamburg, has recently published a set of tables designed to assist meteorological observers in the determination of their monthly means. The idea originated with Dr. Köppen, who prepared a set of such tables for use in the Physical Observatory in St. Petersburg, but Dr. Grossmann has enlarged and improved them. The tables are so arranged that the results of a division, by 31, 30, 29, or 28, can be seen at a glance, the quotient being given up to four figures. We do not doubt that Dr. Grossmann's publication will be found very useful by many observers who now spend a good deal of time in calculating their monthly means.

TITLES OF RECENT PUBLICATIONS.

FURNISHED BY MR. OLIVER L. FASSIG, LIBRARIAN, U. S. WEATHER BUREAU, WASHINGTON, D. C.

(An asterisk [*] indicates that the publications thus designated have been received by the Editor of this JOURNAL.)

ANDREE, S. A. *Iakttagelser under en Ballongfärd den 4 Augusté* 1894. (Bih. K. Svenska Vet.-Akad. Handl., XXI., No. 3.) 12mo. Stockholm, 1895. 13 pp. 3 pls.

ANDREE, S. A. *Iakttagelser under en Ballongfärd den 29 November* 1894. (Bih. K. Svenska Vet.-Akad. Handl., XXI., No. 5.) 12mo. Stockholm, 1895. 20 pp. 3 pls.

CEYLON. ADMINISTRATION REPORTS, 1894. Part II. *Scientific Meteorology.* Fol. [Colombo, 1895.] 35 pp. 3 ch. 1 table.

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COSTA RICA. INSTITUTO FISICO-GEOGRAFICO NACIONAL. *Anales.* Tome V., 1892. [Contains hourly meteorological observations for 1892.] Fol. 1895. 119 pp.

DUNWOODY, H. H. C. *Weather conditions of the crop of* 1894. (Reprint from Year book of the U. S. Department of Agriculture for 1894.) 8vo. Wash., 1895. 15 pp.

*HARTL, HEINRICH. *Meteorologische und Magnetische Beobachtungen in Griechenland.* Ausgeführt von H. H. (Extr.) Mitth. K. K. militär.-geogr. Inst., B. XIV. 8vo. Wien, 1895. 55 pp. 5 pls.

*INDIA. METEOROLOGICAL DEPARTMENT. *Report on the administration of the Meteorological Department of the Government of India in* 1894–95. Fol. Calcutta, 1895.

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*IOWA WEATHER AND CROP SERVICE. *Annual report for the year* 1894. 8vo. Des Moines, 1895. 52 pp. 1 table.

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LICK OBSERVATORY. *Report on the total eclipse of the sun, observed at Mina Bronces, Chile, on April* 16, 1893. Contributions from Lick Observatory, No. 4. 8vo Sacramento, 1895. 126 pp. 11 pls.

MÉRIDA, YUCATAN. OBSERVATORIO METEOROLÓGICO DEL INSTITUTO LITERARIO DEL ESTADO. *Registro de observaciones pradicadas en Mérida, Estado de Yucatan, en el mes de Agosto de* 1895. Felix Gómez, Director. 1 sheet 10 x 18 inches. Mérida, Agosto 31, 1895.

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ROUSDON OBSERVATORY (DEVON, ENGLAND). *Meteorological Observations for the year* 1894, *made under the superintendence of Cuthbert E. Peek.* Vol. XI. 4to. London, 1895. 34 pp.

*SAXONY. K. SÄCHS. MET. INSTITUT. *Ergebnisse der meteorologischen Beobachtungen im Jahre* 1894. (Deutsches Meteorologisches Jahrbuch für 1894. Jahrg. XII., I. Hälfte.) Chemnitz, 1895. 140 pp. 3 pls.

*SCHREIBER, PAUL. *Ueber registrireude Regenmesser und Pegel.* Extr. from: *Civilingenieur*, xli., 1895. pp. 374–386. 2 pls. 4to. Leipzig, 1895.

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